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Statement of

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Administrator

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Subcommittee on Energy
Committee on Science and Astronautics
House of Representatives

Mr. Chairman and Members of the Subcommittee:

I am pleased to have this opportunity to discuss with the Subcommittee NASA's views on H.R. 10952, the "Solar Heating and Cooling Demonstration Act of 1973."

Accompanying me today are Mr. Charles W. Mathews, Associate Administrator for Applications, and Mr. William Woodward, Director of NASA's Space Propulsion and Power Division.

I understand that since H.R. 10952 was introduced in the House of Representatives less than a month ago, by you, Mr. Chairman, and by Chairman Teague and Congressmen Mosher and Goldwater, more than one hundred other Members have joined as cosponsors. We appreciate the Congressional interest in the exploitation of solar energy, an area in which NASA has been involved for a number of years in connection with the space program. As a result of this long experience with solar

energy, in January of 1972 NASA and the National Science Foundation jointly organized a Solar Energy Panel to assess the potential of solar energy as a national energy resource and to survey the state of the technology in the various solar energy application areas. This panel was established under the Energy R&D Goals Committee of the Federal Council for Science and Technology. Mr. William Woodward was a co-chairman of that Panel. The report of that Panel, published in December 1972, has contributed significantly to an understanding of what needs to be done to exploit the solar energy resource, in all of its various forms.

Before addressing H.R. 10952 specifically, I believe it would be useful to the Subcommittee if I would take a few minutes to summarize what NASA is now doing in the solar heating and cooling area.

Since the very beginning of the space program, thermal control of spacecraft has been one of our greatest challenges. In meeting that challenge we have developed within NASA and its contractors competency in a number of discipline areas -- in materials, thermal control coatings, heating and cooling technology and thermal analysis techniques -- which bear directly on the efficient collection and use of solar energy. In the Skylab program, for example, the Marshall Space Flight Center developed a thermal control coating with unique properties which increase its solar collection efficiencies, resulting in higher operating temperatures, and yet which is economical to apply.

The higher operating temperatures in turn allow more efficient operation of absorption refrigeration cycles. Thus this coating holds promise for solar energy cooling systems as well as efficient heating systems.

Our work in solar heating and cooling of buildings draws upon the capability we have developed in our space programs. This "dividend" to the nation in non space-related areas where technology needs to be developed and refined or demonstrated in commercial applications is one of our fundamental objectives in NASA. Essentially, our work includes advanced research and technology, a residential systems engineering demonstration program, and the planned use of a large new office building as a test bed to obtain realistic engineering and operating experience.

It may be useful at this point, Mr. Chairman, to describe briefly a typical solar heating and cooling system to give the Subcommittee a feel for the technology and systems involved. The primary components of one type of solar energy heating and cooling system are shown in Figure 1. In this system water is heated as it passes through a solar collector and is then stored in a tank. In the winter, the hot water would be circulated to the building heating system; in the summer, the hot water would be used to power an absorption refrigeration system to supply cold water or chilled air for use in the building air conditioning system.

It is generally recognized that the "pacing" component in providing practical solar heating and cooling systems is the development of an inexpensive and efficient solar collector. Presently, commercially available collectors cost too much ($5-$20 per square foot) and are inefficient (20-30%). To be practical costs must come down sharply (perhaps to $1-$2 per square foot) and efficiencies must be increased, maybe even doubled.

An example of our technology work is a program at the Lewis Research Center to conduct standardized tests of the most promising solar collectors. To conduct this program we have designed a test facility which can accurately simulate solar radiation at variable and controlled intensities and incident angles. By using this test facility, we will be able to provide accurate standardized test and performance data on the variously configured solar collectors which have been developed. Such data are essential if the cost and efficiency goals I have mentioned are to be realized.

In addition to the collector program, NASA is conducting similar technology programs aimed at improving the performance and reducing the cost of cooling systems. As a part of this program, NASA Lewis Research Center is building a small scale (3 kw) model systems test facility which will be used to test the several heating and cooling components as a system in order to obtain component interactions and system performance. This

facility will also be used to simulate and evaluate many types of residential and commercial buildings in the various climatological areas of the country.

At the Marshall Space Flight Center we are proceeding with a building heating and cooling engineering demonstration test program using the thermal coating which was developed in the Skylab program, as well as the technologies developed at Marshall in spacecraft environmental control systems. In this test program a 1,500 square foot solar collector designed by Marshall will be installed as a "roof" over three surplus trailers which simulate a living area, as shown in Figure 2. The system includes the basic components of the collector, a "three-day" energy storage tank using water as the storage medium, a commercially available (heat powered or "Servel-type") heating and air conditioning unit, and an automatic control system also built from commercially available equipment. An auxiliary heater is also provided, as is typical, to heat the water when the stored thermal energy is inadequate.

The Marshall demonstration unit is not an "optimized" system in terms of collector or storage capacity, but is representative of the size required for a single-family dwelling. The demonstration is planned to be "on line" by the end of this fiscal year.

At the Langley Research Center, we plan to utilize solar energy to heat and cool a Systems Engineering Building, a

"construction of facilities" project which was approved in the FY 1974 Authorization and Appropriations Acts.

This 50,000 square-feet, one-story office building, as far as we know, will be the first building of its size in the world for which solar energy will provide a significant part of the building's heating and cooling load. As shown in Figure 3, we plan to locate the "collector farm," the hot and cold water storage tanks and the necessary pumps and controls in a field adjacent to the building. Although we envision that ultimately solar collectors will be integrated into building designs, we chose the contiguous location to permit convenient modification of the "test bed" and lower initial capital investment.

Our analyses indicate that a solar collector system of 48,000 square feet would collect all the energy required to supply the heating and cooling needs for the Langley Building. In view of the economics involved and the present state-of-the-art, a 15,000 square foot collector is planned since this size collector will provide most of the heating requirements, some of the cooling requirements and test the energy storage capacity in order to obtain feasibility data on all aspects of the system. As these data are analyzed and the state-of-the-art advances, we will be able to expand the collector system to supply all the energy requirements for the building.

We plan to begin construction of the building in January 1974, with the building and solar collector system being completed by January 1975. It is anticipated that testing of the solar heating and air conditioning system will begin in February 1975.

In each of these projects, which are proceeding in close coordination with NSF, the Administration's designated lead agency on solar research, we expect to acquire the kinds of data and experience which could contribute significantly to a demonstration program such as that contemplated in H.R. 10952.

I should also point out that NASA is proceeding with the $2 million energy research effort which was authorized in the FY 1974 Authorization Act. This effort will include studies of space and earth-based solar power generating systems, microwave energy transmission systems, studies related to clean fuels systems and to energy and environment conservation systems, as well as proceeding with the solar heating and cooling projects I have discussed.

With this background, then, let me turn to H.R. 10952.

As we understand it, this bill would authorize and direct an interagency cooperative program -- involving NASA, the National Science Foundation, the Department of Housing and Urban Development, the Department of Commerce, working through the National Bureau of Standards, and the Department of Defense.

The bill would provide for the demonstration of residential solar heating technology on a large scale -- perhaps as many as 2,000 heating units -- within 3 years; and a similar demonstration of the technology for combined solar heating and cooling of buildings in 5 years. It would further provide for a demonstration program of solar heating and cooling of commercial buildings, factories and industrial buildings.

Under the bill, NASA would be assigned the task of developing and contracting for the production of the heating units and the heating and cooling units to be used in the demonstration programs. $50,000,000 would be authorized to be appropriated to NASA during the first five years after enactment of the bill (1) to carry out these functions and (2) to reimburse the other agencies for their efforts.

We are still in the process of preparing our formal report on H.R. 10952, as requested by the Committee. Indeed, we would hope that these hearings will sharpen our focus on H.R. 10952.

Two underlying assumptions appear to be made in the bill:

- First, that the use of solar energy for heating and cooling has great potential in our era of fuel shortages and environmental concern; and
- Secondly, that this potential will be realized only after practical solar energy heating and cooling systems have been demonstrated to be economically competitive with conventional systems.

I believe in these assumptions, although insufficient data are available at this time either to prove whether solar heating and cooling would be commercially viable or to select an optimum system to be used in a demonstration program. In the NASA efforts already under way, one key objective is to provide essential technology and systems information for use in necessary "trade-off" studies and to help provide a needed data base. One important "trade-off" is to decide between solar heating alone in the initial phase, or solar heating and cooling combined into a single system. We agree that the state-of-the-art of solar heating is somewhat more mature than that of combined solar heating and cooling. However, at the moment, we feel that they should be thought of as elements of a single integrated program -- with the "heating and cooling" portion being a desirable extension of and conducted in parallel with the earlier "heating" portion of the program.

Also, although each climatic region presents its own peculiar challenges, the need should be recognized for modular and hopefully standardized systems to avoid, to the maximum extent possible, having "custom-built" solar heating and cooling systems.

In his June 29, 1973, Energy Message to the Congress, the President set forth the actions he was taking to improve the Federal organization of energy activities. Among these actions was the proposal (embodied in H.R. 9090) to create an Energy Research and Development Administration (ERDA). This new Administration would have central responsibility (in the words of the President) "for the planning, management and conduct of the Government's energy research and development and for working with industry so that promising new technologies can be developed and put promptly to work."

The demonstration projects in H.R. 10952 would appear to come within the scope planned for ERDA, and we urge that the President's comprehensive plan be taken into account in the Committee's further consideration of H.R. 10952.

This will insure adequate consideration of the critical questions confronting such a project: What priority should be assigned solar energy development in relationship to other energy efforts? What would be the best timing of a

solar demonstration project to maximize its impact in the marketplace?

As you know, the President requested in his energy message of November 7, 1973, that the Congress act on his energy legislation, including H.R. 9090, which would create ERDA, before the close of this session. That action should be the first priority of Congress on the energy front.

Mr. Chairman, this concludes my prepared statement.

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SOLAR ENERGY FOR HEATING & COOLING BUILDINGS

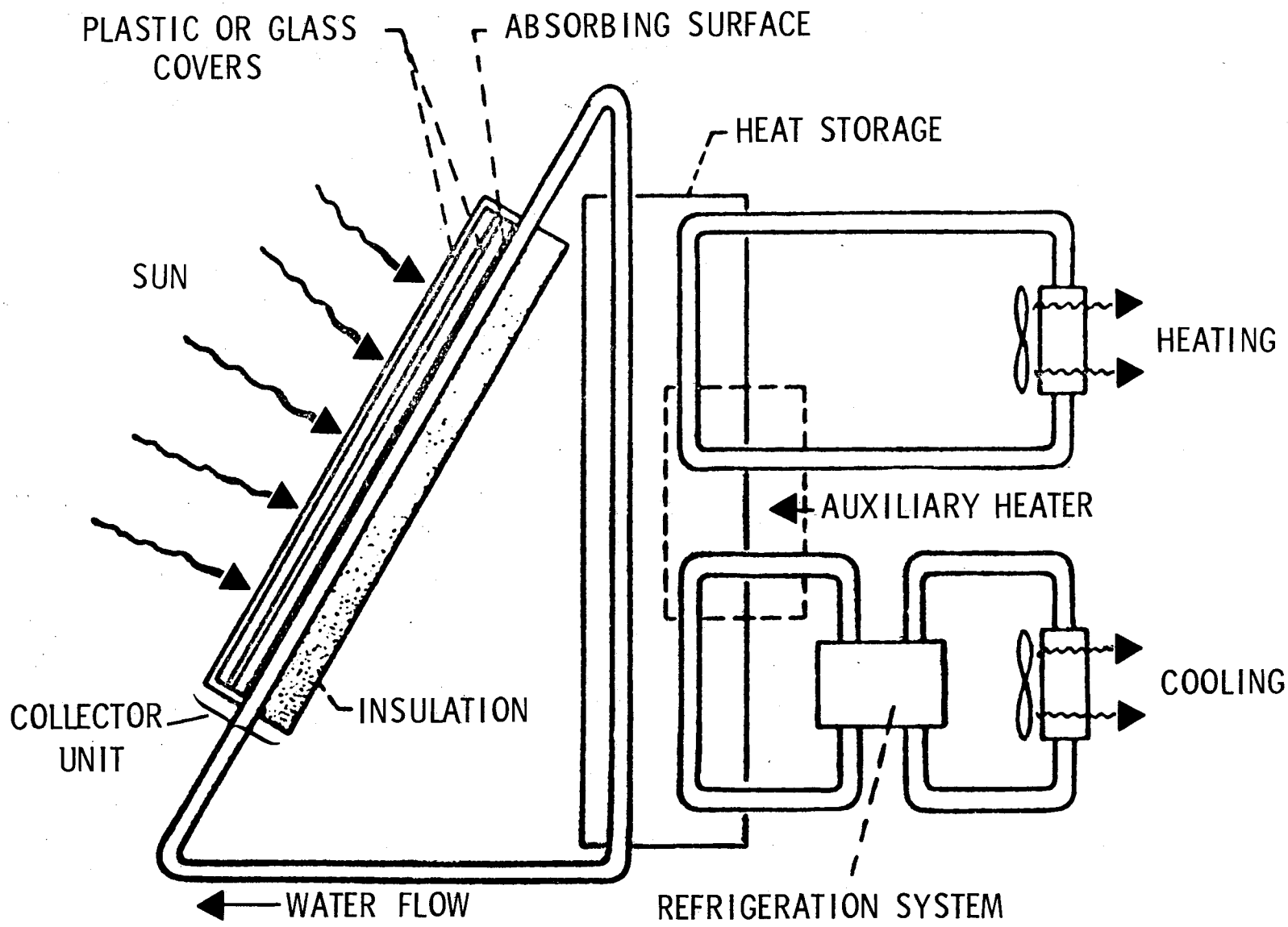

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Figure 1

MARSHALL SPACE FLIGHT CENTER'S SOLAR POWER RESIDENTIAL HEATING AND COOLING PROJECT

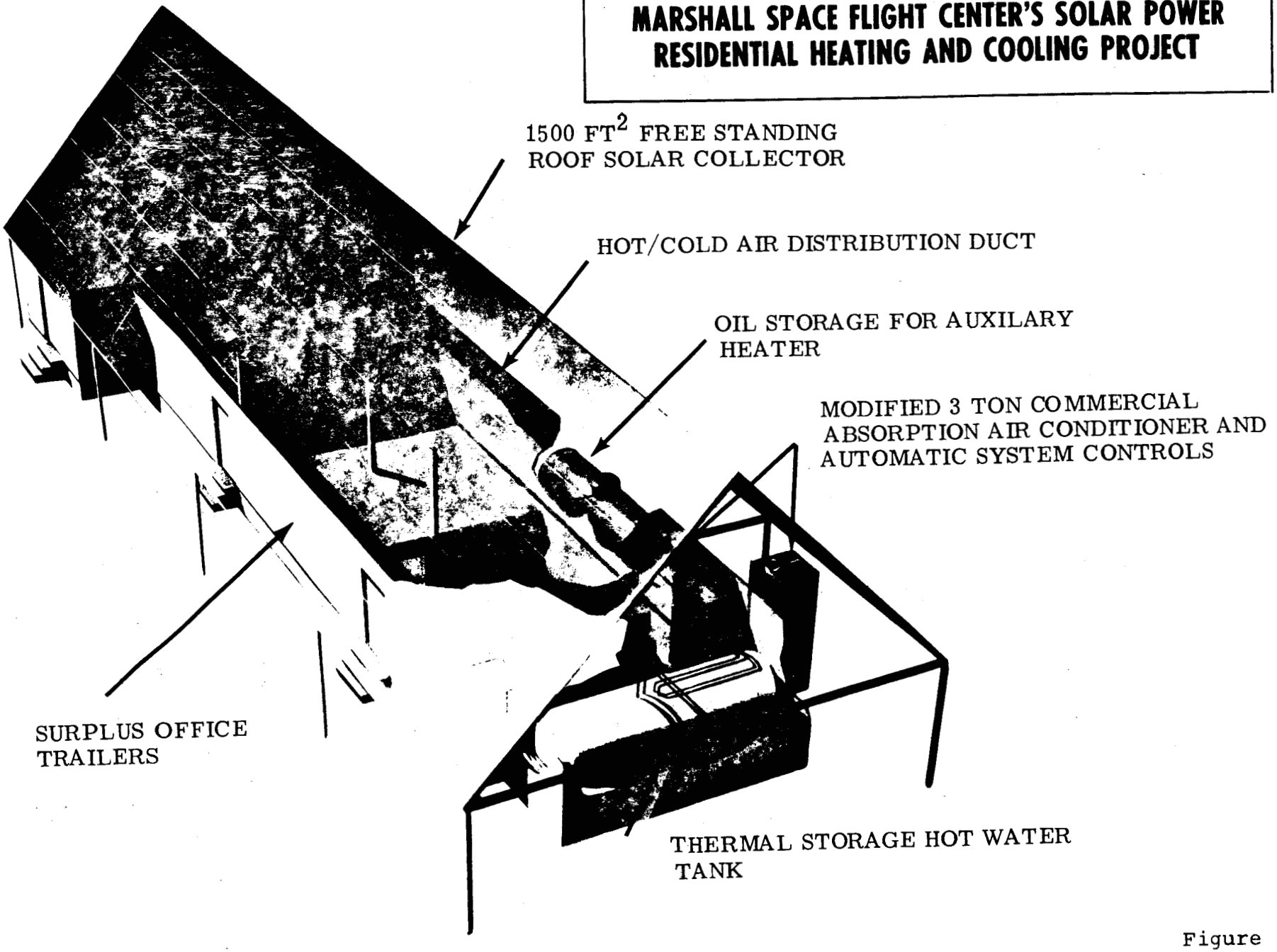

Figure 2

SOLAR COLLECTOR TEST BED
LANGLEY RESEARCH CENTER

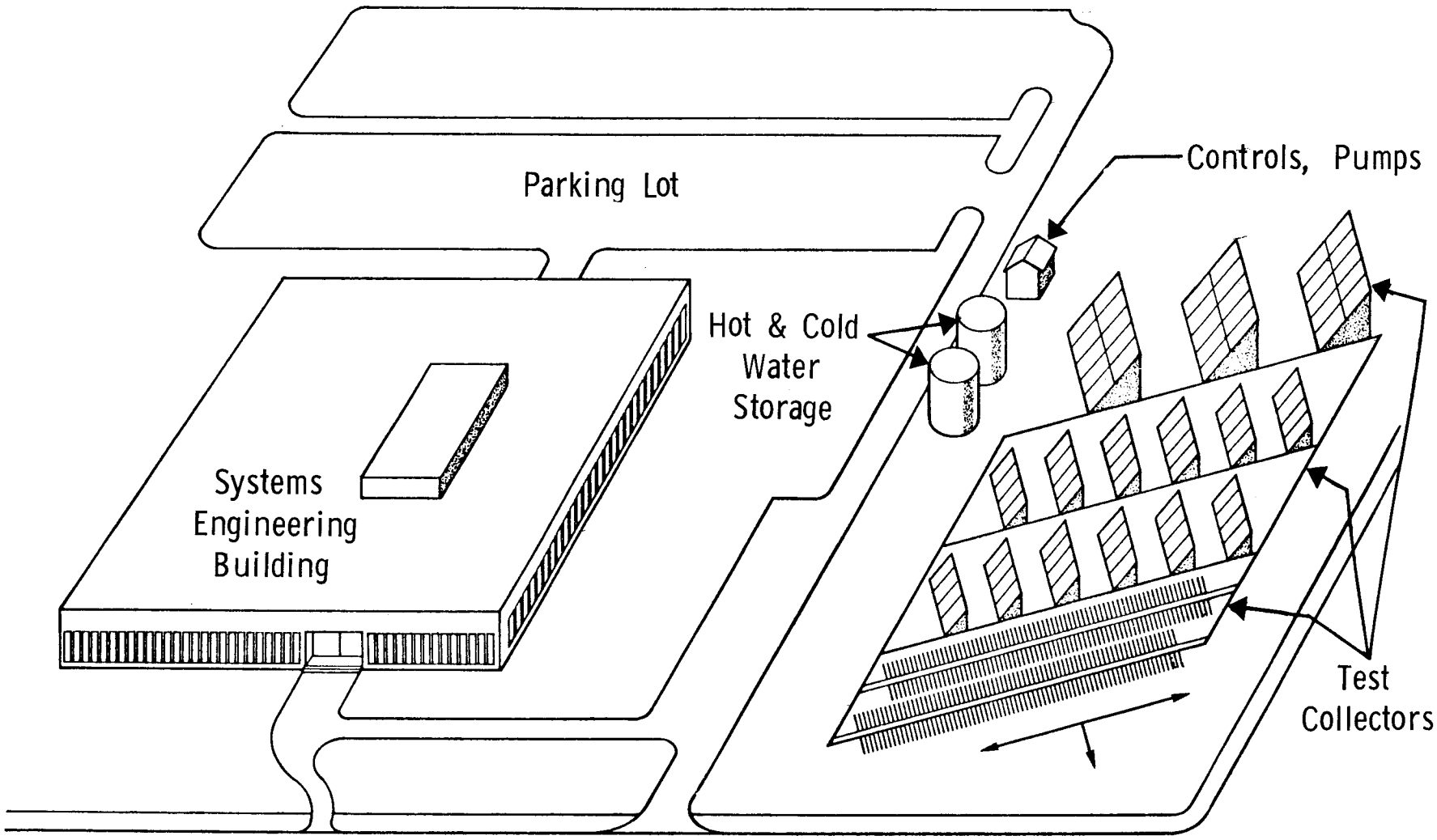

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Figure 3